

ABSTRACT

Greatly improved is an initial efficiency, which would be otherwise low as a fault, without reducing a magnitude of an initial charge capacity, which is a feature of a lithium secondary battery using an SiO as an negative electrode. A cycle characteristic is improved. In order to realize the improvements, a thin film of silicon oxide formed by vacuum vapor deposition or sputtering as an negative electrode active material layer 32 on a surface of a collector 31. The thin film is formed preferably by means of an ion plating method. The silicon oxide is SiO_x ($0.5 \leq x < 1.0$) and a film thickness is in the range of from 0.1 to 50 μm . A vacuum vapor deposition source that is used is an SiO deposit having a weight decrease percent (a rattler value) in a rattler test of 1.0% or less. In vacuum vapor deposition, the surface of the collector 31 is applied with a cleaning treatment in a vacuum or an inert atmosphere and thereafter, a thin film of silicon oxide is formed on the surface of the collector without exposing the surface of the collector to the air atmosphere.